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His Grace the Archbishop of Dublin mentioned the fact that tar was found to be an effectual preservative against the Potatoe disease, provided the potatoes intended for seed be previously dipped in tar slightly warmed.

The Rev. Dr. Robinson gave an account of the present condition of the Earl of Rosse's great telescope, and detailed some observations made with it during a recent visit to Parsonstown.

In 1845 he had laid before the Academy the results obtained by Sir James South and himself, at the first trials of that magnificent instrument. The most remarkable of them had reference to what has been called the Nebular Hypothesis, in which it is supposed that nebulous matter forms suns and planets by its gradual condensation. Above fifty nebulæ, selected from Sir John Herschel's catalogue, without any limitation of choice but their brightness, were *all resolved without exception*. From this he conceives himself authorized to ask, is there any evidence that nebulous matter has real existence?

The appearances which were supposed to indicate the gradual condensation of this imaginary fluid, namely, an increase of brightness towards the centre (sometimes almost looking like a star surrounded by a faint atmosphere), were shown to be caused by a peculiar construction of the systems in which they had been found. This the telescope demonstrated to consist of a central cluster, mostly globular, of comparatively large stars, surrounded by an exterior mass of much smaller and fainter stars, whose arrangement is often circular and thin like a disc. When seen obliquely, they seem like long oval or pointed rays; and in this case, from the optical condensation of their component stellar points, the resolution is more difficult, but even here it was invariably effected.

He has often been asked why this instrument had given no further results. They who put the question had but a

faint idea of the overwhelming pressure which the last three years exerted here on all who were resolved to discharge the duties which men owe to their country. Lord Rosse is not a person to seek knowledge or enjoyment in the heavens, when he ought to be employed on earth ; and he devoted all his energy to relieve the present misery and provide for the future. During this interval some parts of the machinery which could be finished by his workmen without his superintendence, were completed ; a duplicate speculum, which had been previously cast, was ground and polished by them ; but nothing of note was performed except the discovery of the spiral arrangement in 51 Messier, and the resolution of the great nebula of Orion, both which have been published by Dr. Nichol.

These days of evil are past ; and though the future is still dark and threatening, yet he trusted it would bring nothing but what wisdom and benevolence might turn to good ; and in this same hope Lord Rosse felt himself at liberty to resume his favourite pursuits. Dr. Robinson found the new speculum imperfectly polished, and the old one tarnished by wet, which had found access to it while it was not attended to. No difficulty was apprehended in repolishing ; but for a long time the process failed unaccountably. The figure was hyperbolic, and the surface irregular. This last can be easily ascertained during the operation. For the first two hours, the peroxide of iron used as the polishing material covers the surface with scratches, which gradually disappear afterwards. If these be examined by the reflected image of a lamp or window, when the work proceeds well they appear as dark lines, otherwise they show a luminous edge indicating a curvature of the adjacent surface ; and whenever this occurs, the definition will prove imperfect. Weary at last of these trials (each of which involved four days of hard work), Lord Rosse determined to experiment on one of the three-feet specula, which, as Dr. Robinson formerly explained to the Academy, could be examined on the engine, by a dial placed above the tower where

it stands.* Here also there were five or six failures, till Lord Rosse noticed that there was a difficulty in keeping the speculum properly coated with peroxide of iron; and the disturbing cause was soon detected. The pitch of which the polisher is made possesses the requisite consistence only at the temperature of 55° . At that time, however, it was below freezing, and it was necessary to warm the laboratory by stoves. The air of that room, therefore, became drier, and evaporated the moisture from the speculum and polisher too rapidly. On examining this with the wet-bulb hygrometer, they found in one instance 17° difference. This was remedied by a jet of steam from a small pipe connected with the boiler of a steam engine, which was regulated so as to keep the air nearly saturated with moisture; and *at once* all difficulty was removed. The speculum defined the dial-mark quite sharply with a power of 3800, and, when placed in its tube, left nothing to be desired. The six feet was polished with equal success next day, February 16.

Originally the movement in right ascension was given through a handle moved by the observer. This was found inconvenient; and the apparatus is connected with a drum below, moved by a workman. It is found that this will afford a ready means of mechanical movement by clock-work, which is now in hands. The arrangement chosen by Lord Rosse is a gigantic *metronome*, the pendulum of which will carry a gradua-

* If a lucid point be at the distance d from a parabolic mirror, whose focal length = f , its image is formed at a distance from the principal focus for central rays,

$$z = \frac{f^2}{d-f};$$

for a zone whose distance from the axis = y : this distance is further increased by

$$z = \frac{\frac{1}{2}y^2}{d-f} \left\{ 1 + \frac{y^2}{8f^2} \right\};$$

z can be measured for different zones, and if it have *this value*, the speculum must be parabolic.

tion or polar distance, to which the assistant will set the sliding weight at the same time that the telescope is set on an object. It has been ascertained by trial that the elasticity of the impelling band (100 feet long) is quite sufficient to equalize the intermitting movement of such a scapement.

In searching for known objects, there is, of course, occasional difficulty in finding them, from the small field of view of ordinary eye-glasses. This is remedied by a supplemental eye-piece of very wide field; a slide carries it, and the holder of the others, so that by a little shift one can be substituted for the other in an instant. The eye-piece is similar to one which Dr. Robinson had long since made for his own instrument. It consists of three lenses; and fulfils the three conditions of equal flexure of the pencils, achromatism, and flat field, while its distinctness is equal to a Huygenian of equal power. In this one the field-glass is six inches diameter; it magnifies 216 times with a field of *thirty-one* minutes; and though this will only bring into action forty-three inches of the mirror, yet even so its optical power is very great; and Dr. Robinson thinks the view of the moon in it the most magnificent spectacle he ever saw. A nebula is easily found in this wide field; and bringing it into the centre, the eye-slide is shifted, and it is viewed with the higher powers.

The micrometer also appears deserving of notice. Notwithstanding the prodigious light of the telescope, it was found that any illumination of wires extinguishes many of the fainter details in *nebulæ*. Lord Rosse, in drawing 51 Messier, used a very ingenious substitute, a screw whose threads were rubbed with phosphorus. Dr. Robinson had made experiments with a micrometer whose platina wires were faintly ignited by a voltaic current; he found, however, that the heated air produced tremors quite incompatible with the use of high magnifying powers. An experiment of Mr. Babinet, described in the *Comptes Rendus*, has suggested a contrivance which seems quite satisfactory. If light be admitted through the

edge of a piece of parallel and peliucid glass, *it cannot escape through its faces*, because it is incident on them at an incidence greater than that of total reflection. Looking through the faces, therefore, the field of view is absolutely black, unless there be bubbles or striæ in the glass; but if a scale of any kind be engraved on either of them with a diamond, the light escapes through the cuts, and they appear luminous. The division are 6", and the eye-piece has, of course, a position circle.

Dr. Robinson regrets that he had very few opportunities, while at Parsonstown, of using the telescope, in consequence of the unfavourable weather, and of the circumstances which have been stated. Most of them, too, occurred while the speculum was imperfect; yet some facts which he observed may be worth the notice of the Academy.

In the moon may be mentioned that the wide surface at the bottom of the Crater Albategnius is all strewn with minute blocks, not visible in the three feet with 500. The exterior of the mountain Aristillus is all hatched as it were with deep gullies radiating towards its centre; and he was able to confirm his former observations, that the bright streaks which radiate from some craters (Kepler in this case) are not raised above the surface.

Jupiter was several times seen. The dark brown belts presented, on February 20, a remarkable appearance; they were full of faint striæ running nearly parallel to them, and seemingly belonging to the brighter zones on each side. The colour of the belts is deepest at the centre, and gradually dies away towards the edge. This he regards as evidence that they are seen through an atmosphere of considerable depth and imperfect transparency. From this too, and from the fact that the polar regions present a similar though less intense shade, it is evident that the darker parts are the body of the planet, and the brighter its clouds.

Several nebulæ, in addition to those which were men-

tioned in Dr. Robinson's former communication, were examined. Of these, Nos. 505, 540, 668, and 988 of Herschel's catalogue are mere globular clusters : 65 and 66 Messier are of the other class, which he considers to be central clusters, surrounded by discs of smaller stars seen obliquely. The first, however, is less elliptic than in Herschel's fig. 53. 1 Messier was examined, but little addition can be made to Lord Rosse's description of its appearance in the three feet,* except that the "nebulosity" is all resolved, and "the resolvable filaments" consist of pretty large stars. There is, however, in the body of the cluster one so much larger than the rest, that it can hardly belong to their system.

The great nebula of Orion was completely resolved in those places which presented the mottled appearance, even in indifferent nights, and while the speculum was imperfect. On February 20, after it was in good order, a power of 470 showed the stars quite distinct there on a resolvable ground ; and this clearly separated into smaller stars with 830, which the instrument bore with complete distinctness. This diffusion of so many knots of stars through a vast stratum of others much more minute is a most wonderful sight ; and while looking at it he could not help speculating on the aspect which the heavens would present to an observer there. Yet, possibly, the Milky Way, if viewed from without, in the direction of Taurus, would exhibit something similar. The Magellanic Clouds, as described by Sir J. Herschel, are evidently analogous systems. On the same evening an eighth star was found in the trapezium, a seventh having been discovered on the 10th ; the first near Herschel's α , and in the opposite direction from the sixth one detected by Sir James South's large achromatic, and more distant ; the second near β . It is worth mentioning, as illustrative of the effect of previous knowledge on vision, that

* Phil. Trans. 1844, p. 322.

having ascertained the parts where the stars were most distinct, he was able to see them in the three feet with certainty ; though in former years he had repeatedly scrutinized it for this very purpose in vain.*

Two remarkable exceptions to the general plan of nebular systems are afforded by 64 Messier, and h 464. In general the centre is occupied by a cluster of comparatively large stars, round which the others are grouped. But in the first of these (Herschel's fig. 27) there is a central vacancy looking absolutely black by contrast with the surrounding mass of stars. At its south and preceding *edge* are disposed, rather irregularly, a knot of about 100 larger stars, of which it is scarcely possible to doubt *that they had once formed the usual globular cluster in the vacancy*, and had been in some way displaced from it. The second is a fine planetary nebula *in* the splendid cluster 46 Messier. The stars of the latter are large and very brilliant, so that probably it is not very remote ; but the other is a round disc, entirely composed of minute blue stars, without any condensation in the middle ; and the singularity is, that it is not encroached on by the stars of 46 Messier. One very large one is near its edge ; but evidently it would not be possible to describe a circle of equal diameter in any other part without including several. Are we to suppose that this is a case of mere optical connexion ? The probability is very

* A recent notice mentions that Mr. Bond, of Harvard University, in the United States, has resolved parts of this nebula with a Munich achromatic similar to that of Pulkova. The climate and lower latitude would assist him in some degree ; but Dr. Robinson thinks his success must be in a great measure due to that precise knowledge of the phenomenon, and of the points where it might be looked for, which is afforded by Dr. Nichol's work. He perceived the fifth and sixth stars of the trapezium, but saw nothing of the new pair. It must be remembered that, however sharply an achromatic may define objects whose light is intense, its illuminating power is far inferior to that of a large reflector. An object-glass of sixteen inches has not as much light as a *Newtonian* of twenty-one.

small, of a cluster such as 46 Messier (which is not common), and a large planetary nebula (which is very rare) coinciding ; and if we combine with this the probability of a round cavity through one being exactly the size of, and in a line with the other, that probability will be evanescent. It seems, therefore, necessary to conclude, that both are parts of the same system, and possibly more examples of the kind may be found.

Two other clusters, 37 and 50 of Messier, besides their own marvellous beauty, interested Dr. Robinson on another ground ; they are in the Milky Way, and, therefore, are seen on its stars, and at a place where its depth is nearly a maximum. Now, these stars were all of notable size and brightness, so that the telescope evidently penetrated far beyond their enter or limit. This seems to require a change in some of the reasonings in Struvè's admirable *Etudes d'Astronomie Stellaire*. The author, among other curious matter, by applying the theory of probabilities to the numbers of stars of each magnitude in Argelander's Catalogue, and Sir W. Herschel's Star gauges, and by assuming that all stars are nearly equal, and that the Milky Way is unfathomable by telescopes in its greatest extension, finds this result, that the distance of the sixth magnitude is about seven times that of the first, and that the smallest stars visible in the eighteen-inch reflector of Herschel are $25\frac{1}{2}$ times as remote as the sixth magnitude. But this telescope should show stars at three times that distance, and hence he infers that the "heavenly space" is not perfectly transparent. It appears to Dr. Robinson that the last of these assumptions is inconsistent with the above-mentioned observation ; and that the other is equally at variance with the arrangement so often referred to, in which the central stars are much larger than the exterior. It may also be added, that the *penetrating* power of a telescope does not depend on its light alone, for every one knows that a high magnifying power shows small stars, which are invisible in the same tele-

scope with a lower one. The "sweeping power" was only 157, and though it was the best for finding nebulæ, it was much too low to give the utmost range of vision.

But far the most singular objects which he has seen are the nebulæ which exhibit a spiral arrangement. He re-examined 51 Messier, Herschel's fig. 25, in which Lord Rosse had first seen it, and fully verified it: he could not, however, satisfy himself that it was to be traced in the three feet. On the night of March 11 (the only fine one, by the way, which occurred during his stay), he found several others, of which, however, it is difficult to give an idea without drawings.* In 99 Messier the centre is a globular cluster, surrounded by spirals, in the brighter parts of which stars are seen with 470: these have the same direction as in Messier 51, namely, from *east to west*, in receding from the centre. But these are combined with traces of another system in a reverse direction. h 604 is also spiral, but without any other peculiarity. 97 Messier is a strange object. With the finding eye-piece it looks like a figure of 8 with a star at the intersection, but with 470 it is spiral with two centres. The principal one still looks like a star, but with 830 gives a suspicion that it is a very small cluster.† The spirals related to this have the same direction as the former; but the other centre, which also looks like a minute star, has a smaller set in the opposite direction. Lastly, h 731, his fig. 43, in which the stars seem larger than the preceding, but in which no central cluster was observed, has curved dark bands across it, looking so like the section of a turbinated shell as to induce a suspicion that this has a similar arrangement, but is seen edgewise.

On the dynamical condition of such systems it would at

* Drawings of M 51, M 99, M 97, and h 731, were exhibited.

† The next power is 1550, but it was impossible to use it effectually without a clock movement. This is also the case with single lenses, which are particularly effective on such objects.

present be idle to speculate; it must evidently be much more complicated than that of the ordinary globular clusters, which themselves are intricate enough. Their resemblance to bodies floating on a whirlpool is, of course, likely to set imagination at work, though the conditions of such a state are impossible there. A still more tempting hypothesis might rise from considering orbital motion in a resisting medium; but all such guesses are but blind. He believes it is Lord Rosse's purpose to make drawings of all these, *based on rigorous measurement*, which may serve as evidence of change hereafter, should such occur to any perceivable extent during the ages that are yet to come. The instrument will henceforward be regularly employed by an assistant, whom Dr. Robinson has trained for the task, and on whose zeal and steadiness he can rely; and as it cannot be turned to the sky without revealing something wonderful and glorious, he is certain that it will yield an unfailing treasure to science, that it will realize the high hopes of its generous master, and be one of the proudest distinctions of his country.

April 10th, 1848.

REV. HUMPHREY LLOYD, D. D., PRESIDENT,
in the Chair.

William Armstrong, Esq., Michael Barry, Esq., James Christopher Kenny, Esq., Rev. Joseph Fitzgerald, and Rev. William Graham, were elected Members of the Academy.

The Rev. R. V. Dixon made some remarks on the different conditions necessary to ensure a steam engine's working at "full pressure," and at "uniform pressure."

"A steam engine is said to work at 'full pressure' when the pressure of steam in the cylinder is equal to that in the boiler, or rather (as strict equality cannot exist while the ma-